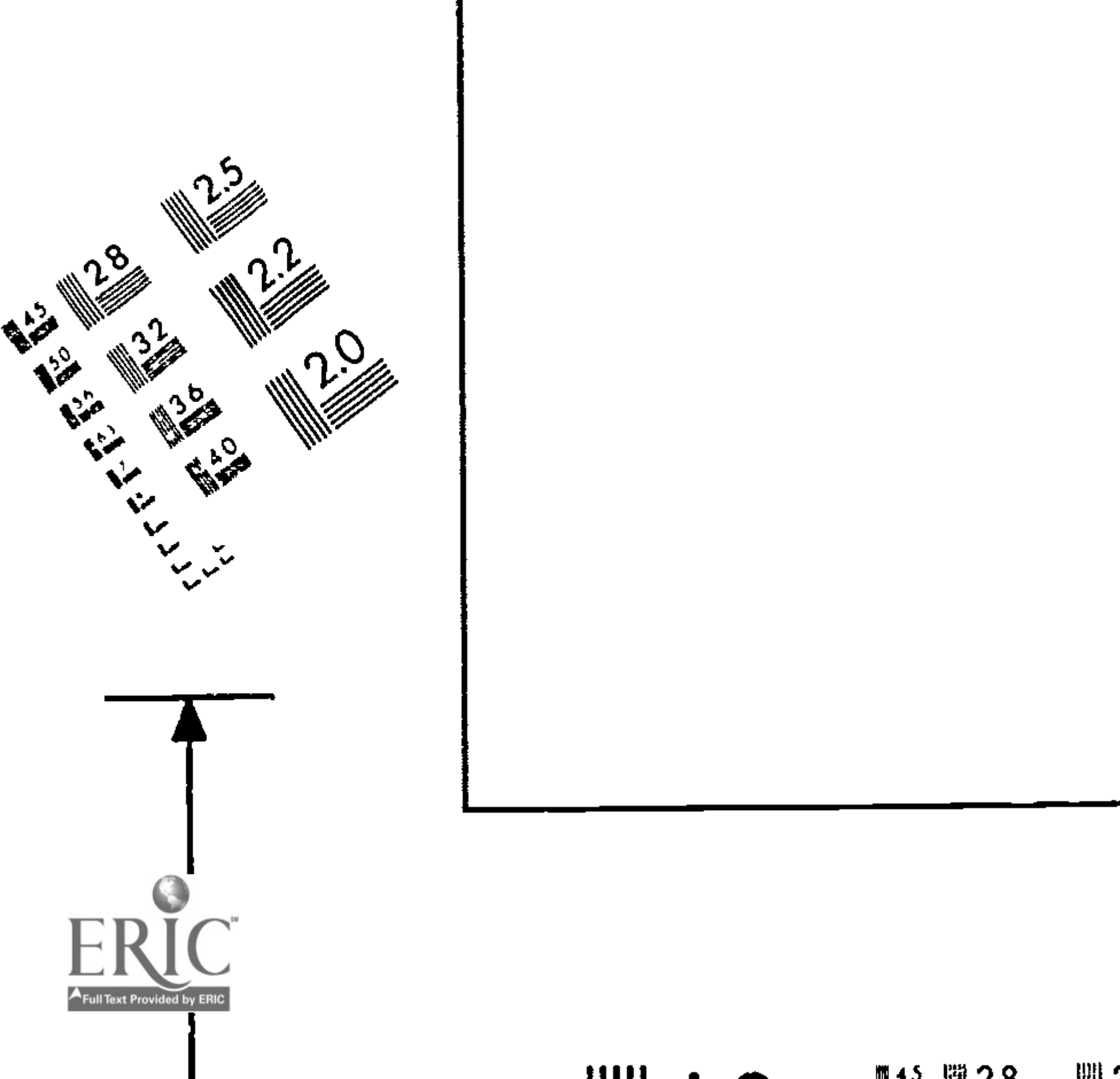
2.5
2.8
2.2
3.2
2.0
3.6
4.0

DOCUMENT RESUME

ED 321 743 IR 014 510

AUTHOR Rymaszewski, Rachel, Ed.
TITLE Information Technology and Language Development. Occasional Paper InTER/10/89.
INSTITUTION Economic and Social Research Council, Lancaster (England).; Lancaster Univ. (England). Dept. of Psychology.
PUB DATE Jul 89
NOTE 29p.; A product of the Information Technology in Education Research Programme. One page each in the introduction section and the references section is partially blank.
AVAILABLE FROM ESRC InTER Programme, Department of Psychology, University of Lancaster, Lancaster LA1 4YF, United Kingdom (single copy) free).
PUB TYPE Information Analyses (070) -- Reports - Descriptive (141) -- Collected Works - Conference Proceedings (021)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; Computer Software Development; Courseware; *Curriculum Development; Elementary Secondary Education; Foreign Countries; *Information Technology; *Language Acquisition; *Language Skills; Research Needs; *Second Language Learning; Seminars
IDENTIFIERS Great Britain

ABSTRACT

This report of a seminar on information technology (IT) and language development begins by presenting background on language skills and information technology in order to define the scope of the topic. The report then pulls together and elaborates on the output of the seminar. The first section discusses media-centered issues, including the design of new media and the exploitation of media. Learner-centered issues covered in the next section encompass cognitive questions, including applications of IT as a support environment for psycholinguistic development and as a domain for new linguistic cognitions; and social questions. The third section deals with institutional issues, including questions of language and curriculum policy and questions concerning classroom practice. The conclusion identifies topics for future research in several areas: (1) the interaction of linguistic theory, IT design, and applied pedagogical issues; (2) the role of IT in individual language development; (3) social aspects of IT use; (4) IT and curriculum policy; (5) classroom practice with IT; and (6) monitoring individual use. A list of seminar participants is included. (89 references) (MES)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ESRC
ECONOMIC AND SOCIAL RESEARCH COUNCIL

U S DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it

☐ Minor changes have been made to improve reproduction quality

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

ED321743

Information Technology and Language Development

Occasional Paper: InTER/10/89
July 1989

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

R. Lewis

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)"

BEST COPY AVAILABLE

Edited by:
DR RACHEL RYMASZEWSKI
DEPARTMENT OF EDUCATIONAL RESEARCH
UNIVERSITY OF LANCASTER

IR014510

ERIC Full Text Provided by ERIC

Origins of the ESRC INFORMATION TECHNOLOGY AND EDUCATION PROGRAMME

The Education and Human Development Committee was established with the reorganisation of the then Social Science Research Council in May 1982. In 1984 the Council changed its name to the Economic and Social Research Council. Early in 1983 the Committee identified and circulated for discussion an initial listing of important topics which warranted expanded support or accelerated development. The broad area of Information Technology in Education occupied a prominent place in that list. The Committee emphasised its intention that research would be centred not only on the effect on education of machines to help teach the existing curriculum, but on the development and adaptation of the curriculum to equip people, including those of school age, to deal with intelligent machines and to prepare them for a life changed by their arrival. For example, there are questions concerning both cognitive and organisational factors which facilitate or inhibit the adoption of Information Technology in Education, and allied to these, questions around the nature, characteristics and development of information technology literacy.

Two reports were commissioned and detailed discussion and workshops were held in 1982. In its further considerations, the Committee was conscious of the fact that the research community is widely scattered and has relatively few large groups of researchers. Furthermore, it recognised the importance of involving practitioners and policy makers in the development of its programme of substantive research and research related activities and the necessity of ensuring close collaboration with commercial organisations such as publishers, software houses and hardware manufacturers. It was this thinking that led the Committee away from the establishment of a single new centre to the appointment of a coordinator over the period 1985 – 88, as the focal point for the development of the initiative throughout the country.

The brief for the Coordinator included:

- the review, evaluation and dissemination of the recent and current activity in the field of Information Technology and Education;
- the identification of the needs of education in relation to Information Technology;
- the stimulation of relevant research and the formulation of research guidelines;
- the establishment and maintenance of a database of relevant work and undertaking arrangements for coordinating and networking of those active in the field including cognitive scientists, educational researchers, practitioners and policymakers.

In January 1988, the Council of ESRC approved a new initiative which would have resources to support a substantive research programme. This programme, the Information Technology in Education Research Programme, gets under way in the autumn of 1988. A new series of InTER Programme Occasional Papers will begin to appear in a similar format to the current ITE Programme series. The latter are listed on the back cover of this paper.

CONTENTS

1. INTRODUCTION

This Occasional Paper is the report of a seminar organised by the ESRC Information Technology i. Education Research Programme. The overall objective for this and other similar seminars is to assist the Programme in setting an agenda for future phases of research.

Eighteen practitioners and researchers from Britain and Northern Ireland with interests in education, information technology and language participated in the twenty-four hour seminar in February 1989. Their interests ranged across teacher education, curriculum development, software development, language testing, second and foreign language teaching, cognitive aspects of linguistic behaviour, developmental psychology, communication skills, and classroom processes.

The seminar did not have a fixed agenda, but a provisional framework of questions to discuss was offered at the outset:

> What particular aspects of mother tongue and foreign language curricula might be significantly aided by IT applications? In particular, what desirable aspects can be introduced or given new emphasis by the technology?
>
> Do communications through new technologies (eg. videotext, electronic mail, hypermedia) demand new linguistic competences on the part of users? How does the use of different kinds of support tools for literacy activities expand our notion of literacy?

An alternative framework based on the identification of issues relating to younger (3-13) and older (12-16) students was discarded as inappropriate by the group on the grounds that most of the interesting issues in IT and language development cross such age boundaries, and that they are not confined to language users below the statutory school leaving age but are relevant to a much wider range of people, including professional communicators, students in further or higher education, adult basic education students, minority community language users in the workplace and so on. It was generally agreed that more interesting questions are generated by distinguishing types and levels of technology, and types of usage, than the age of the learner.

During the initial plenary session a third framework was offered and found useful by many participants. This framework took the interface between information technology and language as having three interesting aspects

[illegible] and [illegible]

Some concern was [illegible] ishing too clearly the first two of these perspectives, since [illegible] ative, and what is new or in prospect today will be commonplace tomorrow. However the distinction can be seen as one between ways of thinking about IT rather than between particular exemplars of IT. In this sense it will be used to structure some of the discussion in sections 3 to 5.

BEST COPY AVAILABLE

In the event the discussions at the seminar fell into three phases:

- Two substantial plenary sessions in which common ground and alternative perspectives were explored.
- Two fairly lengthy sessions in which four sub-groups discussed and proposed issues needing research.
- A short final plenary session in which the four groups compared notes, but without time to pull together or comment on the various outputs.

The function of this report is therefore in part to make such a 'pulling together', drawing on all three phases of the seminar, but inevitably incorporating some new ideas and elaborations, both of the author and of those who kindly commented on an early draft of the report *

Because a common framework for discussion was not agreed at the outset, and because the four small working groups were working to the same brief and therefore each generated a different structure to organise overlapping outputs, it would probably be more confusing than helpful to use the organisation of the seminar itself to structure the substantive part of the report for readers who were not actually present. Instead an attempt has been made to draw on all the contributions under a framework designed to give space to as many of the issues raised as possible. The report which follows, therefore, deals with the research questions discussed under three very broad headings: media-centred enquiries, enquiries relating to institutional practices, and enquiries focussing on learners' behaviour. Of course in practice it will often be at some intersection of these interests that the most pressing research issues arise.

Before laying out the issues as seen at the seminar, however, it is necessary to clear the ground somewhat as to the scope of the topic.

2. CLEARING THE GROUND: SOME TERMINOLOGICAL ISSUES

2.1 *Language Skills*

A striking feature of the discussion was a refusal to talk in terms of language skills, a term used both in the title of the seminar and in the two provisional frameworks offered at the outset. This redefinition of the topic of the seminar was barely articulated by the group, who despite their diverse interests and backgrounds agreed to talk in terms of 'language development' and of communication without explicit negotiation of this redefinition (Garrod and Anderson, 1987). The effect of using a term like 'skill' in relation to language, may be that it encourages thinking about language in terms of discrete behaviours unrelated to a functional context. It is worth making explicit here this common ground of the group since the danger of talking about skills translates into one of thinking of information technology as an instrument for teaching or practising such decontextualised 'skills' (Miller and Burnett, 1986; Solomon, 1986). The converse danger of course, is of conceiving of language abilities as context-bound learned

* I am particularly indebted to Jeremy Fox, Judy Kelner (and colleagues at the University of Reading), Bob Lewis, Neil Mercer, Moira Monteith and Bill O'Neill for detailed comments on the previous draft of this report. I have not been able to do full justice to all their thought-provoking reactions.

procedures, which learners are then unable to reflect on and apply appropriately in new circumstances (Edwards and Mercer, 1987).

Clearly, since information technology is currently used for teaching or practising 'skills' there is scope for researching it in a number of ways. Given the populist political reaction to curriculum prescriptions being offered to teachers on issues such as the teaching of spelling, grammar and punctuation (D.E.S., 1975, 1986, 1988; Peters, 1985; APU, 1988; Lawlor, 1988; Thornton, 1980, 1987; National Curriculum Council, 1988, 1989) one could imagine research designed to discover which forms of computer-based presentation, if any, offer quicker learning or longer retention of, say, spelling patterns or parts-of-speech terminology or foreign language vocabulary than more traditional learning techniques, and why. But in conducting such research the interesting issues are less likely to he to dc with the instructional medium (old or new technology) than with the nature of the activities themselves, such as their meaningfulness for the participants, or the use to which the student is expecting to put the knowledge gained.

An alternative line of research into the use of new information technology in teaching language 'skills' would be one which sought to understand how the introduction of an educational innovation can lead to pedagogical practices quite at variance with the avowed aims of many of its users. For example, educationalists who espouse pupil-originated writing can be found getting their pupils to string together stories from word banks on a Concept Keyboard. This is a phenomenon which is not of course peculiar to the language curriculum - it has been much discussed in connection with the use of computers in the teaching of mathematics too, for example (Papert, 1980; Straker, 1985; Solomon, 1986). On the assumption that the priority of educational and curriculum aims over the use of any particular educational technology is hardly to be questioned, this issue seems to be an important one to resolve.

It is not specifically a language issue, but the current mismatch oetween curricular topics and widely endorsed pedagogical approaches (NCC, 1989; DES, 1989a) and common practices in language may provide a particularly fruitful arena in which to explore this question.

2.2 *Information Technology*

A terminological issue which was explicitly raised in the seminar, if only briefly, was the scope of the term 'information technology'. (The term 'information technology' is used here, it will be noticed, with a scope equivalent to that of 'information and communication technologies' in some usages (Melody, 1985).) In one sense of the phrase, every literate culture uses information technologies, be it clay tablet and stylus (Gelb, 1963), subway train and spray-can (Cooper and Chalfont, 1984), the printing presses of Fleet Street, the domestic TV set with teletext, or indeed the hiro and notepad I'm using at this moment. Indeed oral cultures have devices too, of rhyme and narrative and recitation, which may be regarded as 'information technology' in an even broader sense (Jacobs, 1959). However, the participants in the seminar were aware that the phenomena they had come to discuss were not these. But the newness of the technology (teletext, but not newsprint) is not what distinguishes the information technologies which are assumed to be of interest. The telephone has heen around for a long time, without causing a revolution in classrooms or a redefinition of literacy or a reconceptualisation of the language curriculum, hut this is true of relatively recent

developments in information technology such as video-recording too. In fact it is not information technology which is the centre of attention, nor even new information technology, but *computers* and computer-engined systems (with the peripherals they drive - laser printers, video-discs and compact).

Since it is computer-based information technology that was in focus at the seminar, the report which follows will necessarily also largely be concerned with this corner of information technology. But research should not take for granted the issue of what is selected for use in educational institutions as opposed to what actually succeeds in the marketplace in the wider community. For example, while educationalists are getting excited about electronic mail, facsimile transmission technologies (Fax) have achieved levels of distribution that offer much greater communicative opportunities. It should be acknowledged here that CB radio, telephones, telex and the like also have educational potential that is worthy of exploration, analysis and study. Indeed, in terms of new media through which young people find genuine purposes for communication, and develop specialised uses of language, CB radio and electronic bulletin board systems may have more similarities than differences (Meeks, 1987). It is difficult to say whether the latter were seen as more interesting because of the importance of written language in schooling (and the current high level of interest in the teaching of writing) or whether the discussion at this seminar was heavily biased towards literacy issues because of the implicit agreement that it is computers, rather than other sorts of new technology that was on the agenda.

3. MEDIA-CENTRED ISSUES

Since the arrival of new information technologies and continuing developments in information and communication technologies provide the impetus for exploring their impact on language development in the educational context, some of the questions of interest in this area will be technology-driven ones.

Any educational use of IT will be constrained by the particularities of the hardware and software available, and both research and practice must take account of these pragmatic constraints. However it must be recognised that new information technology has not 'arrived', it is 'arriving' and more than ever we are not operating in a stable system of information and communication. So as well as asking questions in relation to currently available tools and their educational and communicative applications, questions also arise about potentials for enhanced language learning or new language learning roles through the design of new information-processing and communication devices.

These two kinds of media-centred issue are dealt with in the following two sub-sections.

3.1 The design of new media

The use of language reflects the fundamentally intentional nature of human behaviour. In considering IT developments with implications for language learning and development, it is clear that the intentionality paradigm must be central in conceiving and evaluating new media developments.

In asking what kinds of tools are needed to support various kinds of language development, it is helpful to bear in mind a model of language which sees it as

having two major functions – representation and communication (Bruner, 1986). The trend in both first and second language learning and pedagogy in recent years has been to increase the emphasis on the communicative functions of language. So in second language learning in many western countries, listening comprehension and role-play in simulations of realistic situations relevant to the learners' interests and purposes (teenagers, tourists, business people) feature more significantly than in traditional approaches to the curriculum where translation or pattern drills figured more prominently (Munby, 1978; Brumfit and Johnson, 1979; Brown and Yule, 1983). A similar change in emphasis has characterised prescriptions for teaching and developing the first language, (not forgetting that for a significant minority of students in British schools and other educational institutions English is not their first language). It can be seen in:

- the increased emphasis on oral communication skills, (Barnes, 1976; Brown et al., 1984; Maclure et al., 1988)
- the concern in the teaching of writing for the use of writing for genuine communicative purposes and for a range of audiences other than teachers in 'marker' role (Rosen, 1971; DES, 1983)
- the increased emphasis on study skills and the development of appropriate reading strategies for different materials and purposes in the teaching of reading (Lunzer and Gardner, 1979; Fyfe and Mitchell, 1985; APU, 1988).

These changes in emphasis are endorsed in the latest curriculum policy documents (NCC, 1989; DES, 1989a), which also recognise the value of learners using their own community languages to foster realistic communicative situations.

At the same time the role of the representational function of language in social and cognitive development is acknowledged in new approaches to the teaching of writing which emphasise writing processes. The phenomenon of discovering what one thinks, or changing one's mind on an issue through the process of committing it to paper is widely referred to (eg. Murray, 1978; Taylor, 1981; Raimes, 1983). Information and communication technologies, as their name implies, should have the potential to support language development and pedagogical innovations relating to both the communicative and the representational functions of language.

To take the communicative perspective first: a question which exercised the group, and must be worthy of further study, concerned what tools can be designed to provide appropriate contexts for situated language use. Most educational encounters, of course, constitute a communicative 'situation' at one level of description (Edwards and Mercer, 1987). What well-designed computer software may offer are communicative contexts which make particular kinds of demands on the user's language-using competence or language awareness. Many sorts of computer-based microworlds may provide situated contexts for intentional communication (McMahon and O'Neill, 1989). What designers of such software need to know is what are the constraints, for any application, which generate educationally useful experiences with language. For the essence of a micro-world is that it is constrained. It allows the user to do certain kinds of things and not others. The Bubbles software implemented in Hypercard and demonstrated at the seminar (McMahon and O'Neill, 1989) offers an example of how the manipulable features of a microworld may encourage users to develop a particular kind of competence or awareness – in this case of the influence of audience and situation on decisions people make about both what to say and how to say it.

Software of the adventure game genre may also provide valuable contexts for situated language use, for giving students a reason to dig deep into their language resources, and for encouraging them to reflect on language use. But the extent to which they will do this may be to a considerable extent an outcome of how the software has been designed. The designer has scope for incorporating into the design particular features of language, such as non-standard dialects, which language educators want students to think about.

In terms of creating the conditions for new linguistic insights or more sophisticated language use, the more constraining the software, the more important is the design question of what are useful features. By contrast, the more open the software, the more this utility question becomes an issue for classroom practice (see section 5.2). In either case the sources of answers to these questions are likely to have both theoretical and empirical components. They are fruitfully tackled to some extent by observing the use made of prototypes of varying characteristics by learners and teachers. However, the design and production of potentially useful prototypes depends on an analysis of the features of intentional communication which any application might address. This applies as much to the design of intelligent tutoring systems for second or foreign language learning (Button, 1989) as to applications which are more completely in the control of the learner.

The design of more open kinds of software is also an important field for research. The communicative purposes are largely defined by the microworld itself in the cases discussed above, even where the contexts may be supplied by the users. By contrast there is a range of software types which serve as tools for the user's own communicative purposes. These include editors, word-processors, outliners, thesauri, spell-checkers, style-checkers, 'painting' programs, idea-processors, hypertext systems, multi-media interfaces, electronic mail, and so on.

Some of these tools, designed for professional users, are extremely complex and sophisticated, requiring a significant investment of learning time in order to take advantage of their features. The novice user of such tools may be offered the results of one of a number of design strategies for mitigating the cognitive overload of this complexity. These include

- cut-down or simplified versions of the tools;
- software designed such that parts of the system can be quickly learned and used;
- and training methods or documentation which aim to give the beginning user access to a manageable but usable subset of the features.

In the office context, the last approach is commonplace, either through on-line CBT or special tutorial documentation. By contrast, in educational contexts the first approach is common, in some cases to meet the limitations of the available technology rather than the assumed needs of the end-users. Whilst some IT software intended for educational use (e.g. EDFAX) has sought to emulate the 'real thing' as far as possible (in this case Teletext), a number of simplified IT tools have been designed (e.g. MICKEY, EDWORD in the case of word-processors). These varying design decisions represent tacit or explicit views of the short- and long-term relationship between users and tools, that is, of the uses to which the tools will be put. But in terms of helping learners make sophisticated use of their language(s) for communicative purposes there are issues to be raised over the effects of the different design approaches indicated above. For example,

if learners are presented with full-scale tools, such as writer's aids suites, desk-top publishing software or multi-media systems, what features do they want to use, and what features can they put to effective communicative use? The answer to the second question is unlikely to be independent of the pedagogical context in which the tool is offered or introduced. The utility of, say, a style-checking program is likely to be related both to the features of written language it analyses (a design decision) and to the learner's ability to make intelligent decisions about how, if at all, to make use of the information it supplies for a given communicative purpose (a question of language awareness) (Daiute, 1985).

Some software tools support the representational rather than, or as well as, the communicative functions of language. So, for example, the Writer's Assistant being developed at Sussex is distinguished by its creators from other writing aids by reference to the support it offers to writers to externally represent their plans through note-structuring and outlining, and the alternative representations or 'views' it allows them of their intended or ongoing document (Sharples and Pemberton, 1988).

Attempts have also been made to create software tools to aid the construction of arguments (Conklin and Begeman, 1988), or analysis (Smolensky et al., 1987) of debates. Many of the research issues relating to tools of these types will be cognitively or ergonomically based. They will concern the design features which most effectively allow users to represent their ideas and understandings in order to examine or communicate them. The work of Smolensky et al., for example, focuses on the cognitive-ergonomic problem of screen design for allowing users to represent summaries and expansions of a debate in ways which are helpful for managing the cognitive overload of a complex piece of argumentation so that it can be understood or critiqued.

This kind of research falls into the category of looking at the design of new tools. To decide what kinds of new tools are needed one must have an idea of what it is that learners find hard to do. The literature on language can already supply some of these ideas; following a complex argument and critical reading come into this category (Lunzer and Gardner, 1979). The literature on reading also highlights what is hard to teach as well as hard to learn. A famous paper in the 1970's (Durkin, 1979) drew attention to the fact that reading comprehension is often on the curriculum, but classroom observation reveals that whilst it is frequently tested, it is barely taught at all. Whilst some have argued that comprehension, being ineffable, cannot be explicitly taught (Nix, 1983), others have proposed the design of software which could support the acquisition of a wider range of comprehension strategies (Rymaszewski, 1986).

There is much scope for reviewing the language learning literature for the aspects of language development which could most benefit from the design of tools to support them, media in which to exercise them.

A design issue which must be addressed in relation to both 'media' and 'tools' concerns their universality. To what extent is it possible or desirable to design language software which can be used by a wide range of users:

- postgraduate students or advertising copywriters developing persuasive or argumentative skills

- very young children in the initial stages of becoming literate or developing an awareness of language
- second language learners trying to reduce interference from their mother tongues.

Some superordinate issues also need to be addressed however. Given the fast-developing field that is communication technology, and given the fact that the technology available in many educational institutions will lag considerably behind the latest developments, software designers must confront a challenge. To what extent can fundamental features of language and language use, such as intentionality be developed as metaphors for software which are transferable over technology? That is to say ones which can be adapted to function on relatively limited hardware, but can also be transferred and expanded to take advantage of new developments, by making use of real images, dynamic movement, parallel processing, or whatever.

A second challenge for software developers is to design software which not only provides worthwhile learning experiences for the users but also enables useful research data to be gathered.

3.2 The exploitation of media

In discussing the design issues in this section it has not been possible to avoid referring to the issue of how existing or new designs may be exploited by learners. Rather than repeating what has already been said, the issues already raised in connection with the exploitation of new or existing tools are summarised briefly in this section. This will be followed by new material on issues raised by the introduction of new media. A number of different kinds of questions are concerned with the exploitation of tools. One kind of question concerns the use made of the tools available. – What *do* people do, – what do they *want* to do and what can they do with the information technology resources they have? – What will they be able to do with new resources? Learning to make use of new tools has costs as well as benefits associated with it. Using the case of Dungeons and Dragons, Gilmore (1986) has shown that in the right motivational or cultural circumstances otherwise uncommitted students will invest considerable amounts of time and intellectual effort in mastering some difficult aspects of literacy. It is worth studying both the decisions about what to master made by voluntary users of such systems and the areas of success and difficulty of those required to use them, by employers or teachers for example.

Of course teachers as well as learners are exploiters of the media. So another kind of question concerns the decisions of teachers and trainers in using IT to support language development. What are their criteria for selecting particular tools, and could research of the kinds to be discussed in sections 4 and 5 of this paper help to inform those decisions?

Finally there is a sense among users of new information and communication technologies that the learning and language development they enable is interestingly different. But this feeling is not well supported by research. For example, many reports of the effects of introducing word-processing facilities into classrooms

- lack cogent analysis of the difference it might reasonably be expected to make
- lack control over the linguistic and pedagogical setting

- use crude outcome measures

and are based on relatively short exposure to the tool. They reproduce the weaknesses of earlier studies into the effects of learning to program on thinking and planning skills (Goodyear, 1987). What is needed is a less naive approach to checking out these intuitions than the equivalent of these 'what transferable effects on planning skills or mathematics attainment can be found after ten hours exposure to LOGO?' ones.

The availability of new media for representing or communicating ideas also generates a number of important issues to be explored.

For example, electronic mail has created new means for rapid communication with some features associated previously with oral communication over a distance (which is reflected in its lack of legal status) and some associated with written communication. So when communicators are both logged on the immediate response and some of the interactivity of a telephone conversation *can* be simulated. When they are not, or when they have other priorities, the message is available for later inspection as a letter or an answerphone message would be. There are interesting differences between letters and answerphone messages. They tend to be at different ends of the 'edited' continuum, though frequent users of answerphones may pre-compose their message more, or generate 'templates' to guide the generation of messages and avoid the phenomenon of omitting crucial information. Owners of answerphones often include such prompts, for example about leaving names or telephone numbers in their pre-recorded messages. These adaptations to communicating in new media provide an interesting field of study for linguists. Studies of the use of electronic mail have already begun. Work has been done, for example, on the conventions being set by users for this new form of discourse - some borrowed from other media and some new creations (Duranti, 1986).

A new type of medium which is currently receiving a lot of interest (Woolley 1988) has acquired the family name of 'hypermedia'. The earlier term 'hypertext' was coined to describe systems for creating and browsing linked 'cards' of textual information. The use of the term 'hypermedia' reflects the extension of the approach to non-textual media as well, including visual and audio images and sequences. A distinguishing characteristic of these media is said to be 'non-linearity' (Conklin, 1987). Of course print-on-paper text is only linear from the point of view of its presentation. A more helpful way to characterise the structures of information allowed by hypermedia is as 'not merely hierarchical', though this again is true of much expository text. What is interestingly different about the medium is the kinds of strategy appropriate to using it both for 'reading' and 'writing' and it is here that research can fruitfully be focused.

Different implementations of the hypertext idea offer different levels of representation of the non-linear network or database that the user can create or explore. Some automatically create representations of the network at different levels of detail (browsers), by which the user can use as a map to orient themselves by. In other systems such browsers would have to be created and updated manually. Some allow the links between cards to be typed or labelled and others don't. Some allow only one node in the network to be inspected at any one time, whereas others allow multiple windows on the database. Some allow much easier or more sophisticated use of non-textual media than others.

There is enormous scope for the study of how the features of these kinds of systems can be exploited. The earliest systems were created as tools for the collaborative production of in-house papers and reports in software companies (Trigg, Suchman and Halasz, 1987). It is not hard to see them as exploitable in pursuit of language curriculum goals, such as encouraging collaborative writing, producing information to be used by classmates, reflecting on the reliability of information in multi-user systems and so on. But the considerations which will exercise writers aiming to produce ultimately linearised paper versions will be quite different from those creating material to be read 'on-line' in whatever order the reader chooses. Writing in this medium offers new challenges. Writers must no longer assume that a reader will already have read any particular material. The onus is on them to provide the reader with whatever navigational aids, such as labelled links or heading cards, the system allows. Perhaps it is in a novel context like this that teachers may see for themselves the role of modellers of the writing process and sharers of the experience of struggling with writing advocated both in the research literature (Graves, 1983) and current prescriptions (NCC, 1989).

'Reading' hypermedia also poses new challenges. Some difficulties, such as getting disoriented (Foss, 1987) are already being researched. The difficulty of dealing with 'chopped up' text might be turned to educational advantage if, in a hypertext system, readers were asked to label the links between cards or card elements and thus construct the rhetorical structure of the text.

Some technologies, like those enabling learners to produce 'real print' with all that that implies for genuine communication to real audiences in appropriate genres, are not necessarily all that new in themselves but are newly available to non-professional users and in particular to those in the process of becoming literate. Theories of language pedagogy highlight the importance of real purposes and real differentiated audiences in acquiring literacy. It would seem that desk-top publishing and associated "real print" technologies, if teachers exploit them appropriately, offer a significant proving ground for these theories.

4. LEARNER-CENTRED ISSUES

As the foregoing discussion has already indicated, many questions in the area of IT and language relate to what learners or users are able to or want to do with it.

Some of these intersect with design issues. For example the willingness of users to interact with a system, or their style of interaction with it may be influenced by its 'persona'. Others intersect with institutional issues. For example studies of the role of adults in the 'zone of proximal development' (Vygotsky, 1978) for making children aware of what they can do may be conducted in classroom settings or may produce results which are worth feeding back into classroom practice. But others still will focus very closely on the learners themselves. For example studies might observe how in learners' use of IT they evolve a common language for collaborating on a task (O'Malley, Draper and Riley, 1984; Garrod and Anderson, 1987).

In the interests of clarity the following discussion is subdivided into cognitive and social questions, but this division will inevitably obscure some interconnections between the two.

4.1 Cognitive questions

To reiterate an issue mentioned in section 3.2, an important question will whether IT makes a difference to problems about developing effective communication already identified in the ('old' information technology) literature. In the area of literacy such problems include:

- the recognition of reading as a meaningful and purposeful human activity (Goodman, 1982; Smith, 1982a; Waterland, 1985)
- the development of appropriate information-handling strategies for different kinds of printed materials (Thomas and Harri-Augstein, 1976; Schools Council, 1981; APU, 1988).
- the development of 'deep' and of critical reading attitudes (Stauffer, 1969; Saljo, 1984; Lunzer and Gardner, 1984; Rymaszewski, 1987).
- the reconciliation of young children's desire to write with their capacity to handle the technology of writing (Clay, 1975; Graves, 1978; Smith, 1982b).
- the adaptation of writing to audience (Bereiter and Scardamalia, 1982; DES, 1983)
- the development of an ability to write in different genres (Kress, 1982; Kroll and Wells, 1983; Jordan, 1984)
- the perception of pieces of writing as the interim products of an on-going message-shaping process (Donovan and McClelland, 1980; Graves, 1984; Hounsell, 1984)

Questions of this type concern the difference IT may make to existing language practices and demands on oracy and literacy. They can be distinguished from those which concern how the human mind responds to the new cognitive demands made upon it by the use of new tools and new media . This distinction can be related to that made in section 3.1 between designing software with a particular aspect of language development in mind and looking at linguistic consequences of using general-purpose tools.

a) IT as a support environment for psycholinguistic development

Information technology has the potential to support both representational and communicative uses of language, and language awareness. This is worthy of investigation from the cognitive perspective.

At one level it is possible for software to be designed in such a way that the use made of it can be recorded. This may be a dribble file of keypresses registering the use of word-processing software, or student records of module selection, practiced items or test performance in tutorial or drill programs. These records can serve as one source of useful data on a learner's decisions, whether in trying to learn foreign language vocabulary or verb inflections, or in the process of composing a piece of writing within some particular constraints. In some cases such data might be useful to users in reflecting on their learning. The circumstances in which learners can make fruitful metacognitive use of such data is itself a substantial research question.

Our current understanding of the mental representation of knowledge is as a representation with, at best, only a partial correspondence to its linguistic expression in spoken or written text. The advent of IT tools which are not purely textual, or which allow new ways of externally representing knowledge through

icons, graphics, databases or hypermedia, give scope for tackling cognitive science questions about the role of different kinds of external representations, including linguistic ones, in mental processing.

The public availability of knowledge representations is an aid to their conscious use in problem solving (Ridgway, 1988). In a similar way, computer-based IT may have a role in the development of self-conscious language processing strategies such as 'deep' or critical reading (Saljo, 1984; Brown, et al., 1986; Stauffer, 1969).

As well as investigating the role of IT in supporting self-conscious language processing, a study of its role in facilitating language awareness and awareness of ones own linguistic resources would address the inextricably connected social and cognitive dimensions.

b) IT as a domain for new linguistic cognitions

Some reference to this topic has already been made in section 3.2 in talking about the different demands made on users of systems with different organisational bases (text books, encyclopedias, hypermedia, relational databases). In particular, as IT comes to allow greater use of multi-media presentations, the metacognitive strategies people develop for coping with this richness will be of considerable interest. As well as the textual media just referred to, computer users are increasingly expected to handle verbal graphic languages, such as icon systems (Twyman, 1982; 1986) and we have much to learn about how they do so. It may be that in the area of using multi-media systems there are interesting individual differences. Are users predisposed to handle information in significantly different ways in these kinds of environments (cf. Pask and Scott, 1972)? If so, then this understanding could inform the development of tools to facilitate the management of learning in such choice-rich learning environments.

As well as the problem of losing track of where one is in a complex information system, there is the problem of choosing what information to look at. Where someone is trying to fulfill a tightly defined objective (eg. to find out whether Elizabeth Fry could have heard Beethoven's Ninth Symphony) their success in accessing the appropriate information is likely to depend a lot on the availability of the tools the system offers them for doing it (query languages, browsers) as well as on their strategic use of them. With more loosely defined objectives (eg. to find out about 19th century German composers), the problem of information overload may become severe. It is a problem familiar to users of encyclopedias, but it requires the invention of alternative information management strategies to the paper slip for its solution; these will be different for different media.

4.2 Social questions

Some of the questions focussing on learners that must be confronted when considering IT and language development are primarily social rather than cognitive.

For example what are the implications of multi-media systems with access to various sources of information for copyright and for assessment? In systems with multiple users, and in which text and graphics may be moved around from one source to another, the question of the 'ownership' of a given piece of text arises. Where two or more students have worked together to produce a joint assignment the assessment question is not a problem. But where a student or a group of

students are able to import material from on-line sources into their work, with or without editing it, a rather greyer area is identified.

Looking at the joint construction of texts or other sorts of communication from a different perspective throws up other questions. Whether such multi-authored creations are produced by witting or unwitting partners, the practice throws up interesting questions of autonomy, ownership and identity. The practice of collaborative writing is widespread in the academic and commercial world and is becoming established in the British language curriculum through the sponsorship of the National Writing Project, but it is not well researched. The availability of IT tools which make such collaborative work more easy to engage in and more open to inspection offers a valuable opportunity to make a start on these questions.

A quite different kind of social question concerns the possible distancing effect of IT for community language users. In principle computer-based IT is more easily adapted to representing languages which do not use the Roman alphabet than older print media, but whether that potential is used is quite another matter. Indeed there is scope for IT to act as a decidedly conservative rather than liberating medium. Any British user of an American spell-checking program will know the feeling of being a non-standard dialect user.

The first two kinds of issues raised were in a sense social-ethical questions, questions about the value assumptions inherent in educational or linguistic practices. There are also interesting social questions of a more empirical or anthropological type which can be raised in connection with the use of new means of communication and the kinds of socio-cultural practices with which those means are associated (Street, 1984; Heath, 1983).

New communities of interest have sprung up around new communication media such as c.b. radio, email and electronic bulletin boards. These interest-based communities can be identified and studied. How do the conventions for using these media arise in a group? Ninety-five percent of adolescent bulletin board users in the USA are white, male, and upper-middle class (Meeks, 1987). How is the group membership determined and how can entry to such communities be facilitated?

5. INSTITUTIONAL ISSUES

As well as learners' use of language with IT, teachers' use of IT is also of interest. The learning investment in software tools needed for students to use them in educationally significant ways has already been referred to (section 3.2). However, it is unlikely that teachers will make pedagogically fruitful use of IT without a sense of ownership through a similar learning investment.

This investment may be made through teachers using IT for their own professional purposes, rather than as explicit preparation for pedagogy, as the HMI document on Information Technology 5-16 suggests (DES, 1989b).

Whether teachers will choose to make that investment may depend on the innovation strategies in their institutional context. The institutional context itself cannot be ignored in addressing questions of IT and language development in

5.1 Questions of language and curriculum policy

The use of IT in Education has already been imposed at policy level. One way to look at IT and language in education is to take the institution's given and emergent purposes in relation to language as a starting point and ask what can IT offer? Clearly the National Curriculum currently looms large as one of these. It is based on an explicitly articulated model of language and communication pedagogy (DES, 1988) which in some cases runs contrary to long established practice.

McMahon and O'Neill (1989) suggest a beginning on this kind of question in exploring the use of particular language-oriented software in connection with Education for Mutual Understanding in Northern Ireland. A number of aspects of the language component of the National Curriculum could be tackled in a similar way, such as drafting and redrafting, communication in groups and the selection and use of information. The approach is one of simulating the environment which creates social practices. This simulation is the result of the interaction of a theory-driven approach, the development of specific tools and their use in communicative contexts (Scardamalia and Bereiter, 1989).

Other policy initiatives also generate contexts for exploring the role of IT in language learning. Current moves in the European Community connected with the prospect of the single market in 1992 are highlighting the need for increasing mutual knowledge of the languages spoken in EC member countries. IT may have many roles in relation to this increased language-learning activity. It allows international communication between students for example. It allows engagement with authentic materials, whether public broadcasting output received by satellite, interviews and dialogues in authentic settings with native speakers which can be manipulated as interactive video (O'Neill, 1987), or access to on-line databases and information systems such as Prestel, or Teletel. It also allows the creation of fantasy contexts, of the adventure game genre, which could provide the motivational context for second language learners to stretch their linguistic resources. The role of IT in supporting both the general initiatives and particular features of the foreign language curriculum, such as the use of authentic materials, which are currently valued could be evaluated in this policy context. Many of the lessons learned could have a wider applicability, not only to the effective learning of other world languages, but to the support of minority and heritage languages too.

The questions and examples discussed so far in this section have concerned how IT might support or transform the language curriculum, but there are wider policy questions which could be addressed too, such as equal opportunities. The low participation rate of female students in computer-based activities in schooling is well documented (Moore, 1986; Hoyles, 1988). One account of this phenomenon draws attention to the association of computing with traditionally 'masculine' subject areas such as mathematics and science. Could a higher profile for computer-based activities in language study make a difference? Will male students take more interest in reading or in studying modern languages? Will female students increase their relative levels of use of computers in education?

Even higher-level policy questions can be asked. For example, what is the role of the availability of information technology resources outside the institutional context (eg. in the home, the high street and the workplace) in shaping policy on the educational uses of IT. Again this is not a language-specific question, but the

widespread use of communication technologies may furnish an interesting context in which to explore the more general question.

5.2 *Questions concerning classroom practice*

These questions fall into three general kinds:

- what can we learn from studies of current practice
- what changes in current practice would be fruitful and
- how can they be brought about?

The characterisation of teaching as a theory-based enterprise, the rational planning model, (Tyler, 1949; Gagne, 1985) is much called into question. However teachers' classroom practice can be seen as defining implicit 'theories' about the nature of the subject matter and how it is learned (Calderhead, 1984). In this sense of 'theory', the way teachers use information technology in their classrooms reveals the theories they implicitly espouse. In other words it allows us to infer the model(s) of language they assume, their model of learning (language learning in particular) and indeed their model of curriculum development.

In studying current practice, through case studies or action research, these implicit models must be addressed as they legitimate what is seen as 'good practice'. The questions to be addressed in looking into classroom practice need to be very carefully framed if they are to provide disseminatable results. One can ask what is the effect of introducing a particular IT tool to children of a particular age, but one is unlikely to be wiser without very careful analysis of the classroom context, including not only the teacher's views of language and the language curriculum, but also of the learners' history, the class ethos, the support given to the teacher in making the innovation, common practices, and wider institutional issues.

Indeed the effectiveness of various kinds of support (technical/curricular; classroom/inset), whilst not specific to IT and language, was seen as an important question. Equally, the effectiveness of different teaching approaches is of itself of interest. Many IT tools offer the possibility of a shift of responsibility towards learners, but teachers are unlikely to move in that direction unless it is consonant with their 'theories' of language and learning. How do teachers and students reconcile their approaches to using new information technology? How do they change over time? In what circumstances does the use of IT lead teachers to reflect on their models of language?

It is likely that these sorts of question can be asked at different levels of generality. One can supply classrooms with a whole battery of up-to-the-minute gear, with or without support, and see what happens, as in the approach of Burnett, et al. (1989). Alternatively one can take the case of a particular tool (a style-checker say) and investigate strategies for using it, as in the work of Daiute, (1985). Again at the more particular level one can take a specific language practice such as collaborative writing, or role play, and investigate strategies for supporting or promoting it with IT.

Given the gap between language-learning theory and prescriptions on the one hand and practice on the other, a central question for those concerned with the appropriate and fruitful use of IT in language education is the issue of what are the most appropriate forms of induction for teachers and trainers into the use of IT for communication and language development purposes? Anecdotal evidence

(such as the use of word-processors for producing neat spelling lists) suggests that training and support may be as important in relation to issues of language and pedagogy as it is to particular tools or types of media.

6. CONCLUSION

The foregoing discussion has identified a large range of potentially interesting topics for research on information technology and language development. In spite of a growing number of case studies and practitioner reports (Potter, 1987), we have no systematic and methodologically coherent research base which would enable the confirmation or refutation of claims made for the particular value of IT to support language development.

A research programme in this area needs to be clear about the analytic frameworks it can use to characterise IT media and tools, and IT use, and to characterise language phenomena and patterns of interaction supported by IT.

The key research areas emerging from the discussion and this paper would be as follows.

- The interaction of linguistic theory, IT design and applied pedagogical issues
  - how can our understanding of how language is used for representation and communication, including its uncertainties and ambiguities, be taken account of in the design and development of the hardware and software of new communication media and their exploitation in educational contexts?
  - how can the design and exploitation of new information technology be used to help learners represent and examine their understandings, and communicate them effectively?
- The role of IT in individual language development
  - how can the potential of IT be tapped for enhancing the development of (first and second) language learners as:
    - effective communicators (using oral, written and graphic media)
    - effective users of information?
  - can IT be used to give learners better insights into language
    - as a symbol system;
    - as a means of communication;
    - as a carrier of social and cultural values?
- Social aspects of IT use
  - what are the socio-cultural influences on the voluntary use of information and communication technologies, eg.
    - gender;
    - use of minority community languages;
    - IT-based communities of interest?
- IT and curriculum policy

  in what ways can using IT assist teachers in implementing the National Curriculum, in relation to first, second and community language learning

- IT and curriculum policy

  in what ways can using IT assist teachers in implementing the National Curriculum, in relation to first, second and community language learning

- Classroom practice with IT
  - what insight can studies of classroom practice give us into
    - teachers' implicit theories of language and language pedagogy;
    - learners strategies for handling new language demands using new language support systems;
    - the role of institutional support in relation to both the technology and the curriculum aims in teachers' use of IT in the language curriculum

- Monitoring Individual Use
  - What insight can studies of learners' use of IT give us into learners' implicit theories of language and language use?
  - What use can be made of interaction data
    - by the researcher on IT and language learning;
    - by the learner, for metacognitive reflection?

7. REFERENCES

APU (1988) *Language Performance in Schools: review of APU language monitoring 1979-1983.* HMSO: London.

Barnes, D. (1976) *From Communication to Curriculum.* Penguin: Harmondsworth.

Bereiter, C. and Scardamalia, M. (1982) From conversation to composition; the role of instruction in a developmental process. In L. R. Glaser (ed) *Advances in Instructional Psychology, Vol 2.* Lawrence Erlbaum: London.

Brown, A. L., Armbruster, B. B., and Baker, L. (1986) The role of metacognition in reading and studying. In J. Orasanu (ed) *Reading Comprehension: from Research to Practice.* Lawrence Erlbaum: London.

Brown, G., Anderson A., Shillcock, R. and Yule, G. (1984) *Teaching Talk: Strategies for production and assessment.* Cambridge University Press.

Brown, G. and Yule, G. (1983) *Teaching the Spoken Language.* Cambridge University Press.

Brumfit, C. J. and Johnson, K. (eds) (1979) *The Communicative Approach to Language Teaching.* Oxford University Press.

Bruner, J. S. (1986) *Actual Minds, Possible Worlds.* Harvard University Press.

Burnett, J. D., Blackstock, J., Miller, L. and Warkentin, I. (1989) *Teachers' use of new technology: wave upon wave.* Paper presented at CAL89, University of Surrey, Guildford, April 1989.

Button, C. G. (1989) An intelligent tutoring system for helping children aged 7 to 15 to acquire a second language. *Instructional Science 18,* 27-43.

Calderhead, J. (1984) *Teachers' Classroom Decision Making.* Holt Rhinehart, Winston.

Clay, M. M. (1975) *What Did I Write?* Heinemann Educational Books: Auckland, New Zealand.

Conklin, J. (1987) A survey of hypertext. *MCC Technical Report No. STP-356-86.* Software Technology Program, MCC, Austin, Texas.

Conklin, J. and Begeman, M. L. (1988) gIBIS: A Hypertext Tool for Exploratory Policy Discussion. *MCC Technical Report No. STP-082-88.* Software Technology Program, MCC, Austin, Texas.

Cooper, M. and Chalfont, H. (1984) *Subway Art,* Thames and Hudson.

Daiute, C. (1985) Do writers talk to themselves? In S. W. Freedman (ed) *The Acquisition of Written Language: Response and Revision.* Ablex: Norwood.

DES (1975) *A Language for Life.* Report of the Committee of Enquiry (The Bullock Report). HMSO: London.

DES (1983) *9-13 Middle Schools: an illustrative survey.* HMSO: London.

DES (1986) *English from 5 to 16.* Second edition (incorporating responses). HMSO: London.

DES (1988) *Report of the Committee of Inquiry into the teaching of English Language* (The Kingman Report). London: HMSO.

DES (1989a) *National Curriculum. Draft Statutory Orders for English for Key Stage 1* (mimeo).

DES (1989b) *Information Technology from 5 to 16.* Curriculum Matters 15. HMSO: London.

Donovan, T. and McClelland, B. (eds) (1980) *Eight Approaches to Teaching Composition.* National Council of Teachers of English: Urbana, IL.

Duranti, A. (1986) Framing discourse in a new medium: openings in electronic mail. *Quarterly Newsletter of the Laboratory of Comparative Human Cognition 8,* 2, 64-71.

Durkin, ? (1979) What classroom observations reveal about reading comprehension instruction. *Reading Research Quarterly 14*, 4, 481 – 533.
Edwards, D. and Mercer, N (1987) *Common Knowledge*. Methuen.
Foss, C. L. (1987) Effective Browsing in Hypertext Systems. *CERCLE Technical Report No. 41*. Centre for Research on Computers and Learning, University of Lancaster.
Fyfe, R. and Mitchell, E. (1985) *Reading Strategies and their Assessment*. NFER/Nelson.
Gagne, R. M. (1985) *The Conditions of Learning*. Holt, Rhinehart, Winston.
Garrod, S. and Anderson, A. (1987) Saying what you mean in dialogue: a study in conceptual and semantic co – ordination. *Cognition 27*, 181 – 218
Gelb, I. J. (1963) *A Study of Writing*, second edition. University of Chicago Press.
Gilmore, P. (1986) Sub – Rosa literacy: peers, play and ownership in literacy acquisition. In B. B. Schieffelin and P. Gilmore (eds) *The Acquisition of Literacy: Ethnographic Perspectives*. Ablex: Norwood.
Goodman, K. (1982) What is basic about reading? *Language and Literacy Vol 2*. Routledge.
Goodyear, P. (1987) Sources of difficulty in assessing the cognitive effects of learning to program. Journal of *Computer Assisted Learning, 3*, 4, 214 – 223
Graves, D. (1978) *Balance the Basics: Let them Write* (Ford Report). New york: Ford Foundation, February.
Graves, D. (1983) *Writing: Teachers and Children at Work* Heinemann Educational Books.
Graves, D. H. (1984) A case study observing the development of primary children's composing, spelling and motor behaviors during the writing process. *A Researcher Learns to Write*. Heinemann Educational Books: Exeter, NH.
Heath, S. B. (1983) Ways with Words. Cambridge University Press: Cambridge.
Hounsell, D. J. (1984) *Students' conceptions of essay – writing*. University of Lancaster PhD thesis.
Hoyles, C. (1988) *Girls and Computers*. Bedford Way Papers: Institute of Education, London.
Jacobs, M. (1959) *The content and style of an oral literature*. University of Chicago Press.
Jordan, M. P. (1984) *Rhetoric of Everyday English Texts*. George Allen and Unwin: London.
Kress, G. (1982) *Learning to Write*. Routledge and Kegan Paul: London.
Kroll, B. M. and Well, C. G. (eds) (1983) *Explorations in the Development of Writing*. John Wiley: Chichester.
Lawlor, S. (1988) *Correct Core: Simple Curricula for English, Maths and Science*. Centre for Policy Studies, Policy Study No. 93.
Lunzer, E. and Gardner, K. (1979) *The Effective Use of Reading*. Heinemann Educational Books.
Maclure, M., Phillips, T. and Wilkinson, A. (eds) (1988) *Oracy Matters*. Open University Press Milton Keynes.
McMahon, H. and O'Neill W. (1989) *Language Development and Hypermedia*. Faculty of Education, University of Ulster at Coleraine.
Meeks, B. N. (1987) Computers for communication. In J. Rutkowska and C. Crook (eds) Computers, Cognition and Development. John Wiley: Chichester.
Melody, W. (1985) Implications of the information and communication technologies: the role of policy research. *Policy Studies 6*. (ISSN 0953 – 5209) ESRC: Swindon.

Miller, L. and Burnett, J. D. (1986) Theoretical considerations in selecting language arts software. In P. R. Smith (ed) *Advances in Computer Assisted Learning: selected proceedings of the CAL 85 symposium.* Pergamon Press.

Moore, B. (1986) *Equity in education: gender issues in the use of computers. A review and bibliography.* Review and Evaluation Bulletins, Ministry of Ontario. Education, Vol 6, No.1.

Munby, J. (1978) *Communicative Syllabus Design.* Cambridge University Press.

Murray, D. M. (1978) Internal revision: a process of discovery. In C. R. Cooper and L. Odell (eds) *Research on Composing: Points of Departure.* National Council of Teachers of English: Urbana, Illinois.

National Curriculum Council (1988) *English for Ages 5 to 11* (The Cox Report). DES/HMSO: London.

National Curriculum Council (1989) *English 5–11 in the National Curriculum* (Consultation Report). National Curriculum Council: York.

Nix, D. H. (1983) Links: a teaching approach to developmental progress in children's reading comprehension and metacomprehension. In Fine and Freedle (eds) *Developmental Issues in Discourse* (Advances in Discourse Processes, 10). Ablex: Harwood, NJ.

O'Malley, C., Draper, S. W. and Riley, M. S. (1984) Constructive Interaction: A method for studying computer–user interaction. In B. Shackel (ed) *Interact '84: First Conference on Human–Computer Interaction.* North Holland: Amsterdam.

O'Neill, G. (1987) Interactive Video as an aid to learning. *Programmed Learning and Educational Technology 24,* 2, 138–144.

Papert, S. (1980) Teaching children to be mathematicians v. teaching about mathematics. In P. R. Taylor (ed) *The Computer in the School: Tutor, Tool, Tutee.* Teachers College Press.

Pask, G. and Scott, B. C. E. (1972) Learning strategies and individual competence. *International Journc of Man–Machine Studies 4,* 217–253

Peters, M. L. (1985) *Spelling: Caught or Taught? A New Look.* Routledge and Kegan Paul.

Potter, F. (1987) *Word Processing and Literacy Skills.* Report of the Working Party to prepare for a seminar on Word–Processing. Edge Hill College of H E (mimeo)

Raimes, A. (1983) Anguish as a second language? Remedies for composition teachers. In A Freedman, I Pringle and J Yalden (eds) *Learning to Write: First Language/Second Language.* London: Longman.

Ridgway, J. (1988) Of course ICAI is impossible.. worse though, it might be seditious. In J Self (ed) *Artificial Intelligence and Human Learning* Chapman and Hall: London

[illegible]

Sylvester, R. H. (1987) *Knowledge based study of children's comprehension of expository text.* University of Leeds PhD thesis.

Saljo, R. (1984) Learning from reading. In F. Marton, D. Hounsell and N. Entwistle (eds) *The Experience of Learning.* Scottish Academic Press: Edinburgh.

Scardamalia, M. and Bereiter, C. (1989) *The Psychology of Written Composition.* Lawrence Erlbaum.

BEST COPY AVAILABLE

Schools Council (1981) *Information Skills in the Secondary Curriculum*. Schools Council Bulletin 9.

Sharples, M. and Pemberton, L. (1988) Representing Writing: an account of the writing process with regard to the writer's external representations. *Cognitive Studies Research Paper No. 119*. School of Cognitive and Computing Sciences, University of Sussex.

Smith, F. (1982a) *Understanding Reading* (3rd edition). Holt Rhinehart and Winston.

Smith, F. (1982b) *Writing and the Writer*. Heinemann Educational Books: London.

Smolensky, P., Bell, B., Fox, B., King, R., and Lewis, C. (1987) Constraint-based hypertext for argumentation. *Proceedings of Hypertext '87*.

Solomon, C. (1986) *Computer Environments for Children*. MIT Press.

Stauffer, R. G. (1969) Teaching Reading as a Thinking Process. Harper and Row: New York.

Straker, A. (1985) Another look at primary maths with a micro. In Greater Manchester Primary Contact, Special Issue 3, 35-38. Didsbury School of Education, Manchester.

Street, B. (1984) *Literacy in Theory and Practice*. Cambridge University Press: Cambridge.

Taylor, B. P. (1981) Content and written form: a two way street. *TESOL Quarterly 15*, 1, 5-13.

Thomas, L. and Harri-Augstein, S. (1976) *The self-organised learner and the printed word*. Report to the Social Science Research Council.

Thornton, G. (1980) *Teaching Writing: the Development of Written Language Skills*. Edward Arnold: London.

Thornton, G. (1987) *APU Language Testing 1979-1983. An independent appraisal of the findings*. HMSO: London.

Trigg, R. H., Suchman, L. A. and Halasz, F. G. (1987) Supporting collaboration in Note Cards. *Proceedings of the Conference on Computer Supported Cooperative Work*. Austin, Texas, December 1986.

Twyman, M. (1982) The graphic presentation of language. *Information Design Journal, 3*,1.

Twyman, M. (1986) A schema for the study of graphic language. In *Processing of Visible Language 1*.

Tyler, R. (1949) *Basic Principles of Curriculum and Instruction*. University of Chicago Press.

Vygotsky, L. S. (1978) *Mind in Society: The Development of Higher Psychological Processes*. Harvard University Press: London.

Waterland, L. (1985) *Read with Me: An apprenticeship approach to Reading*. The Thimble Press: Stroud.

Woolley, B. (1988) The non-linear followers of fashion. *The Guardian (24.3.88)*

8. APPENDIX A: SEMINAR PARTICIPANTS

Graham Davies	NCCALL, Ealing College of Higher Education
Jeremy Fox	School of Modern Languages and European History, University of East Anglia
Judy Keiner	Dept of Educational Studies and Management, University of Reading
Bob Lewis	ESRC-InTER Programme, University of Lancaster
Peter Lloyd	Dept of Psychology, University of Manchester
Barry MacDonald	CARE, University of East Anglia
Harry McMahon	Faculty of Education, University of Ulster, Coleraine
Neil Mercer	Centre for Language and Communications, Open University
Moira Monteith	Dept of English, Sheffield Polytechnic
Bill O'Neill	Faculty of Education, University of Ulster, Coleraine
Frank Potter	Faculty of In-service Studies, Edge Hill College of Higher Education, Ormskirk
Rachel Rymaszewski	Dept of Educational Research, University of Lancaster
Anthony Sanford	Dept of Psychology, University of Glasgow
Mike Sharples	School of Cognitive and Computer Sciences, University of Sussex
Peter Skehan	ESOL, Institute of Education, University of London
Bridget Somekn	School of Education, University of East Anglia
Jeremy Tafler	National Writing Programme, SCDC, London
Scott Windeatt	Institute for English Language Education, University of Lancaster

ESRC PUBLICATIONS RELATING TO INFORMATION TECHNOLOGY AND EDUCATION

Available from:

Economic and Social Research Council
160, Great Portland Street
London W1N 6BA
Telephone: 01 – 637 1499

Microcomputers in Education – a framework for research
(Morley Sage and David J. Smith)
Published by SSRC 1983 ISBN 0 86226 125 2 Price £2

Intelligent knowledge – based Systems
– UK Social Science Research Inputs
(Linda A. Murray and John T.E. Richardson)
Published by ESRC 1984 ISBN 0 86226 108 2 Price £2

Information Technology and Education
– signposts and research directions
(Editor David J. Smith)
Published by ESRC 1984 ISBN 0 86226 152 X Price £5

From:

School Government Publishing Company
Darby House
Bletchingley Road
Merstham
Redhill, Surrey, RH1 3DN

Information and Communication Technologies:
Social Science Research and Training
Volume 1: An Overview of Research
William H Melody and Robin E Mansell
ISBN 0 866226 179 1

Volume 2: National Directory
Robin E Mansell (editor) assisted by Barbara Richards
ISBN 0 866226 184 8

Price £10 (two volumes)

From Blackwell Scientific Publications:

Trends in Computer Assisted Education – the proceedings of the 6th Conference on Computers in Higher Education held in April 1986 and supported by CET and the ITE Programme. Published January 1987.

Computer Assisted Learning in the Social Sciences and Humanities – the proceedings of the ESRC International Seminar held in April 1986. Due for publication June 1987.

[For ITE Programme papers, see outside back cover.]

Papers currently available at no cost from:

ESRC – InTER Programme, Department of Psychology,
University of Lancaster, Lancaster LA1 4YF
Telephone: 0524 – 65201 Ext 3601 (24hr. answering)
Fax: 0524 – 841710
DIALCOM: 10001:yma027
JANET: inter@uk.ac.lancs.cent1
EARN: inter%uk.ac.lancs.cent1@ac.uk
DARPA: inter%cent1.lancs.ac.uk.@cunyvm.cuny.edu
EuroKom: ESRCITE_Prog_Lancaster%eurokom.ucd.irl@euroies.uucp

ITE Series of Occasional Papers:

A full list of papers in this series is available from the Programme. Please note that some listed may be available in photocopy form only.

InTER Series of Occasional Papers:

InTER/ 1/88 The Information Technology in Education Research Programme, September 1988

InTER/ 2/88 Artificial Intelligence Applications to Learning and Training – a seminar report to the Training Commission, August 1988

InTER/ 3/88 The InTER Programme: Groupwork with Computers, October 1988

InTER/ 4/88 The InTER Programme: Conceptual Change in Science, October 1988

InTER/ 5/88 The InTER Programme: Tools for Exploratory Learning, October 1988

InTER/ 6/88 The InTER Programme: The Independent Policy Evaluation, October 1988

InTER/ 7/88 Support Tools for Authoring – a seminar report, December 1988

InTER/ 8/89 Research in Progress – update March 1989

InTER/9a/89 A Guide to the Electronic Services, May 1989

InTER/9b/89 The Caucus Computer Conference System, November 1989

InTER/10/89 Information Technology and Language Development – a seminar report, July 1989

InTER/11/89 Barriers to Innovation – a seminar report, July 1989

InTER/12/89 Information Technology – based Open Learning – a Study report, July 1989

InTER/13/89 Authoring Tools for simulation – based CBT – an interim project report, July 1989